

Physical Medicine for Injured Hands

S. MALVERN DORINSON, M.D., San Francisco

INJURY TO THE HAND is one of the most disabling accidents than can happen to a worker. Industry pays more for hand disabilities than for those in any other part of the body and many companies pay more for them than for injuries in all other parts of the body combined.³

Much medical attention has been focused on the proper treatment of such injuries, but most of the emphasis has been put upon the anatomical aspects of treatment. This means adequate examination of the skin, good circulation, good bone alignment, intact tendons and normal skin sensation. The hand is then immobilized so as not to jeopardize any of these anatomical components of skin, circulation, tendons, bones and nerves. However, as Bunnell² has frequently pointed out, "hands are peculiar in that they are prone to become stiffened."

After anatomical healing of the injured part has taken place the immobilization apparatus is removed and usually there is stiffness present. This stiffness has several components: Edema involving all soft tissue structures and particularly the joint capsules; some shortening of joint capsules and of other soft tissues; stiffness of disuse in the muscles, particularly the intrinsic muscles of the hand, which therefore do not function correctly in moving the fingers; and pain, which is a factor in limiting active motion of the joints, particularly during the first few weeks.

All these factors are best and most quickly eased by the various means of physical medicine if they are properly used. Physical medicine includes the use of light, heat, water, electricity, massage, manipulation, exercise and mechanical devices in the treatment of disease. It is most commonly divided into two sections—physical therapy and occupational therapy.

Heat. The purpose of giving heat is twofold. First, it brings about vasodilatation, and with the increase of circulation comes improvement in the metabolism of the hand and removal of tissue metabolites. Second, the heat acts to anesthetize the endings of the nerves that transmit pain and thereby makes possible a greater voluntary effort.

There are many ways to apply heat to various parts of the body, but some of them are not suitable for the hand. For example, infra red is commonly used on the larger joints of the body but is not

• The functional concepts of treatment of the injured hand by use of the various modalities of physical medicine, including heat, massage, electrical stimulation, passive exercises, active exercises, occupational therapy and splints are discussed. Immobilization is often necessary to correct anatomical injuries. Mobilization activities using physical medicine are just as necessary to correct functional deficiencies of the hand occurring either from the injury or the enforced immobilization following an injury.

effective for use on the hand. The efficacy of infra red depends upon absorption by the skin surfaces. Since infra red is beamed on the skin from only one direction, only those surfaces in direct line with the rays are heated. As the hand has relatively large skin surface, only part of the member would be heated.

Diathermy can also be applied to the hand. However, diathermy has its effect mainly through the soft tissues and particularly the vascular tissues, and since there is not much tissue of that kind in the hand, diathermy is not a very effective method for use there.

Hot packs of woolen material soaked with hot water and thoroughly wrung out can also be used for the hand. However, the skin over an injured hand which has been immobilized is usually quite sensitive and will not tolerate hot packs well. Furthermore, there is the usual criticism of hot packs that the heat is not constant; the degree of heat is high at first and then there is gradual cooling. The paraffin glove method is another way to apply heat. The "gloves" are made by rapidly dipping the hand into barely melted paraffin six or seven times in succession until the hand is well coated. After this the hand is wrapped in some insulating material, such as a blanket, and the wrapping is kept on for about 20 minutes. This is a very good way of heating the hand, although it requires that the patient's fingers be immobile while the heat is applied.

The most efficient method of heating the hand is the whirlpool bath. This consists of immersing the hand for 10 to 15 minutes in rapidly whirling water maintained at a temperature of approximately 105°. Besides the effect of heat, there is the added advantage that, with relief of some of the pain by

Presented before the Section on Industrial Medicine and Surgery at the 83rd Annual Meeting of the California Medical Association, Los Angeles, May 9-13, 1954.

the whirling water, the patient can do active exercises in the water by squeezing a sponge or rubber bulb. This treatment should be given daily if possible. Ordinary hot soaks should not be used by the patient at home unless he has been carefully instructed and can be trusted to do active exercise while soaking.

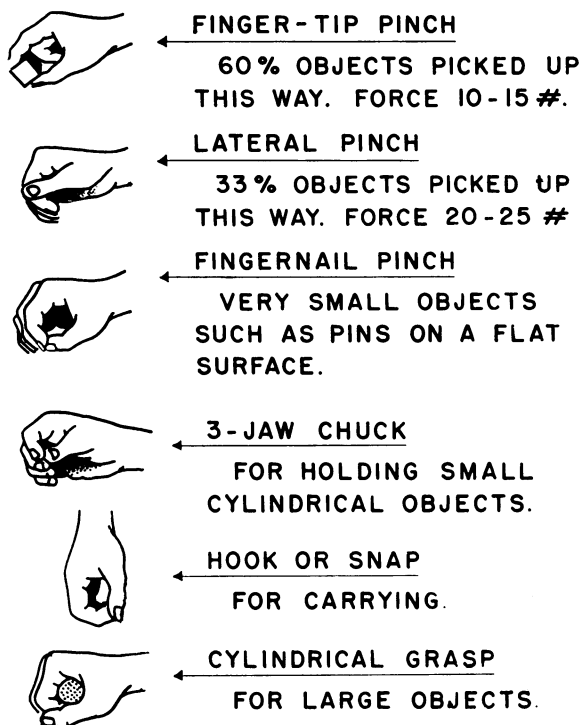
Massage in treatment of the hands has only two purposes. First, edema can actually be massaged out of the hand. Second, by stretching the tight skin, elasticity can be restored and skin circulation can be improved.

Electrical stimulation is valuable if used judiciously. In the first few days after removal of the hand from a cast, when the muscles, particularly the intrinsic muscles, are quite stiff from inactivity, electrical stimulation with galvanic current (or faradic current if the nerve supply is intact) will start contractions of the muscles. The appearance of the hand, particularly its color, often is greatly improved after five minutes of such muscle stimulation. The enforced contractions of the intrinsic muscles greatly stimulate the deep circulation of the hand. Unless paralysis is present, it is usually not necessary to give stimulation more than a week. When the nerve supply has been temporarily interrupted, electrical stimulation is extremely valuable in maintaining elasticity and contractility of the muscles while the nerve supply is regenerating. The type of electrical current to use is that which will give a maximum contraction with a tolerable strength of current.

Passive exercises are useful if done intelligently and with an understanding of what is to be accomplished. Stretching, or even manipulation, might be included within the definition of passive exercise. Although the terms are anathema to many surgeons, in order to mobilize the phalangeal joints it is often necessary to stretch the collateral ligaments. This is done by stretching the joints laterally and also by attempting to rotate one joint on the other. The finger is then grasped just above the joint to be loosened and pulled in the same direction as the bone. While it is being pulled, it is then gradually eased into flexion at the joint being worked upon. This has to be done gently and without extreme force; otherwise harm can occur to the joint capsule as in any other forceful manipulation. If done judiciously, it will improve flexion. Each interphalangeal joint is worked upon individually and also the metacarpophalangeal joint.

Active exercises. This is the major and most effective part of the treatment. The previously described measures are adjunctive or preliminary to it. Active exercises will do more toward improving the circulation, removing edema, stretching out soft tissues and improving muscle strength than any other procedure.

PREHENSION PATTERNS



To function as an all-purpose grasping organ, the hand uses several prehension patterns (Figure 1) for specialized tasks. The most commonly used is finger-tip pinch. A force of ten to 15 pounds can be exerted normally in this fashion for picking up a majority of objects. Lateral pinch is the next most frequently used grip and a normal force of 20 to 25 pounds can be obtained with it. Fingernail pinch is used for very small objects such as pins on a flat surface. The "three-jawed chuck" is formed by the thumb against the index and middle fingers for handling small cylindrical objects. The hook is used for carrying heavy loads, with the thumb acting as the snap or spring to lock the hook. Cylindrical grasp is used for gripping large objects.

All these functions should be worked upon with a definite exercise routine. Telling the patient to squeeze a rubber ball is a mistake for the balls are usually so large and firm that they cannot be squeezed down even by a normal hand. It is much better to have him use a rubber sponge or bulb that can be crushed or pinched in various ways.

The patient must also be taught the proper way for opening and closing the hand in order to gain maximum excursion and to loosen tight structures. Closing the hand involves full flexion, first of the distal interphalangeal joint then the proximal interphalangeal joint and finally the metacarpophalangeal joint. Opening the hand should be done in the reverse fashion. Patients who have painful hands usually close the hand by flexing at the metacarpal

joints first before attempting to flex at the interphalangeal joints. This causes them to use their intrinsic muscles to extend the distal phalanges and therefore makes it almost impossible for the long flexor tendons to flex the distal phalanges by which the fingertips touch the palm and close the hand.

Another point commonly overlooked in active exercise of the hand is the proper use of the thumb. The thumb almost always needs strengthening, particularly of the opponens and abductor muscles. Exercise must be directed to the intrinsic muscles of the hand, since they have been almost completely immobilized and have lost much of their power. Strengthening exercises must be given the muscles of the forearm, particularly the long flexors and extensors of the wrist and fingers. Various devices in the form of spring handles and bulbs of varying resistance, as well as weights and pulleys, are used to gradually increase the difficulty of the exercise. An excellent exercise to improve finger motion and grip is to make a "newspaper ball": A page of newspaper is laid flat and the patient gradually rolls it into a ball starting at one corner and continuing to wrinkle it into the palm without ever releasing it.

Occupational therapy is a much neglected aspect of physical medicine, particularly with regard to hand injuries, where it can help most. Occupational therapy has to be prescribed as precisely as physical therapy. The joint to be mobilized and the muscle to be strengthened should be given occupational tasks requiring repeated motions and continuous use of those joints and muscles. Occupational exercises are much less boring to the patients than are those carried out only for the sake of restoration, for the hand is used in a functional way rather than just to limber a joint or strengthen a muscle. There are special occupational therapy procedures for

hands which include use of various types of tools whose handles have been increased according to the limitations of the grip. There are other types of activities such as woodworking, sanding, finger painting, clay modeling and belt tying. Unfortunately, too often patients and physicians misinterpret the purpose of occupational therapy, thinking it merely a recreational task without any functional purpose. If at all possible, patients should be given occupational tasks for improvement of function of the hand.

Splints. Frequently contractures occur in the hand after injury. It will do little good to carry out physical therapy if no effort is made to maintain corrections in the intervals between treatments. Good results depend upon appreciation of the inherently dynamic function of the hand as opposed to the essentially static nature of the usual kind of splinting.¹ The best splinting exerts continuous traction against the contracted structure yet does not immobilize the hand. Splinting of this kind was described by Bunnell,² who used various arrangements of rubber bands to exert traction at almost any joint of the hand. Such splinting is functional splinting, and as it serves to improve mobilization, treatment is being carried on constantly. This kind of splinting is probably one of the most neglected phases of physical treatment of the injured hand.

442 Post Street, San Francisco 2.

REFERENCES

1. Bruner, J.: Problems of postoperative position and motion in surgery of the hand, *J. Bone and Joint Sur.*, 35A: 355-66, April 1953.
2. Bunnell, S.: Active splinting of the hand, *J. Bone and Joint Sur.*, 28:732-36, Oct. 1946.
3. Flack, F. L.: Hand disabilities, *So. M. J.*, 45:784-89, Sept. 1952.

